PowerLogic DVR

Catalogue 2021

Dynamic Voltage Regulator for steady supply of voltage for continuity in production process

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Contents

Power Quality - Voltage Disturbances



It is well-documented that power quality issues are one of the most significant and costly impacts on electrical systems. Studies have shown poor power quality costs the European economy up to €150 billion annually and the U.S. economy up to $188 billion annually, according to two independent studies by the Leonardo Power Quality Initiative and the Electric Power Research Institute (EPRI), respectively.

One economic model summarizes the total cost associated with power quality events as follows:

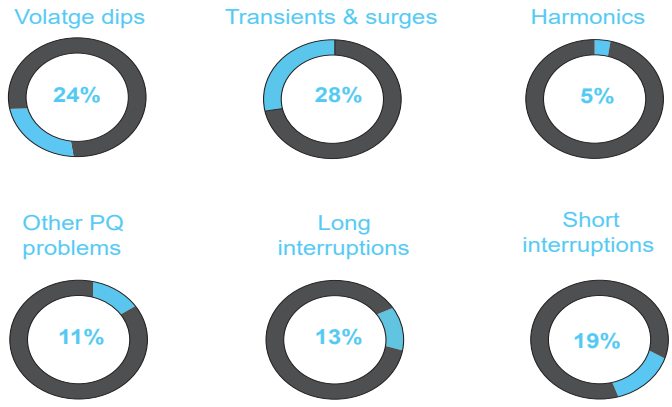
Total losses = production losses + restart losses + product/material losses + equipment losses + third-party costs + other miscellaneous costs

Other miscellaneous costs may include intangible losses such as a damaged reputation with customers and suppliers or more direct losses such as the devaluation of credit ratings and stock prices.

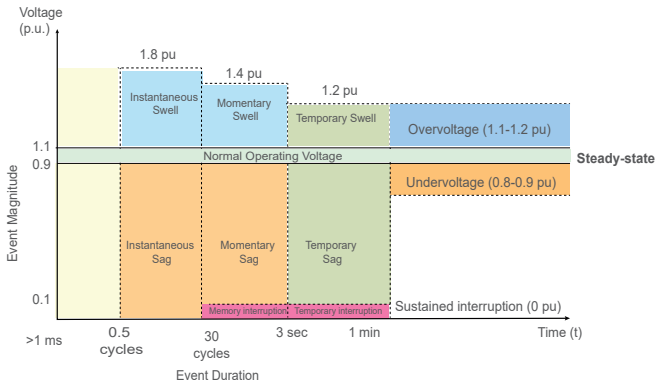
The seven power quality categories defined by IEEE 1159-2019, short-duration rms variations are the most disruptive and have the largest universal economic impact on energy consumers. Short-duration rms variations include voltage sags/dips, swells, instantaneous interruptions, momentary interruptions and temporary interruptions. One study by EPRI estimates an average of 66 voltage sags are experienced by industrial customers each year. As the trend of industries becoming more dependent on sag-sensitive equipment has increased, so has the impact of these events.

In Summary, more than 50% of the Power Quality issues comes from voltage disturbances and Dynamic Voltage Regulator (DVR) is the solution to address the Voltage Sag, Voltage unbalance problems.

Classification of Power Quality Events



Classification of Voltage Disturbances



PowerLogic DVR

The PowerLogic™ Dynamic Voltage Regulator (DVR) is an inventive system designed to mitigate and eliminate the effect of electrical disturbances that can impact critical processes and/or services.

DVR is cost-effective and efficiently protects sensitive loads in power distribution and transmission systems against voltage distortions. It is primarily designed to reduce voltage sags on power lines that cater to sensitive commercial and industrial equipments.

The DVR system consists of a transformer, a reversible rectifier, and an inverter with three modes of operation (Normal Mode, Static Bypass Mode, and Manual Bypass Mode) to meet the requirements of industrial production processes, maintain a stable and constant output voltage regardless of changes in input voltage as defined in the operation limits.

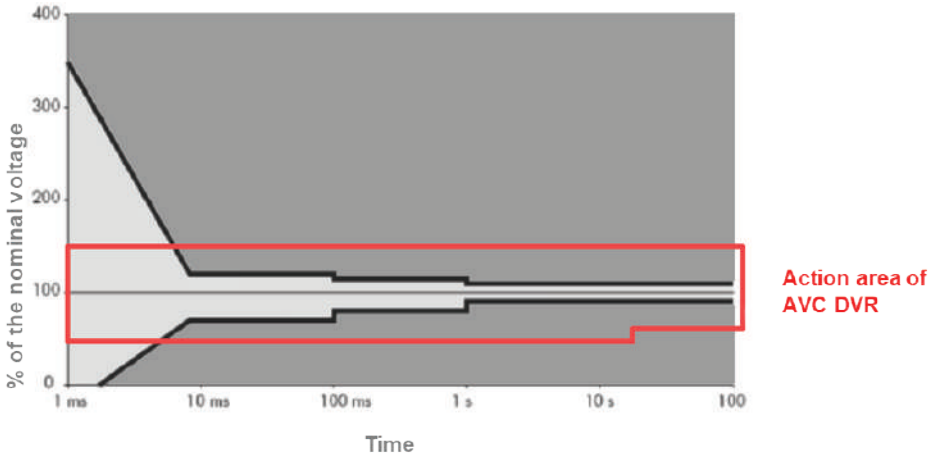
It is designed not only to eliminate voltage sags and it also helps in mitigating other energy quality problems at the same time, such as: fluctuations, flicker effects, overvoltage, and voltage unbalance.

A touchscreen control panel is provided on the front panel of the PowerLogic DVR system to monitor and control the status of the equipment quickly, which allows to view the information on the current operating status, instantaneous and historical sag events details that are corrected by DVR or which is passed to bypass.

The Challenge

Due to natural phenomena, the energy generation systems, transportation systems, and distribution systems have certain limitations. These systems can cause electrical disturbances due to factors such as consequences of manoeuvres, breakdowns, atmospheric phenomena, or disturbances introduced by receivers. These disturbances can affect the processes and/or services and can have significant economic consequences for companies.

Most of the existing equipment in the industry meets the sensitivity curve defined by IEEE 446 standard as shown in figure. The equipment has no problem while the voltage is in between the two lines of the curve, as shown in the light grey area in figure.



Curve as per IEEE 446 Standards

Unfortunately, the electrical grids are not always between the two lines. The disturbances in the electrical grids are represented by dark grey areas and it depends on the magnitude and duration of the disturbance. These disturbances cannot be eliminated completely, so it is necessary to adapt the customer facilities in order to be protected from disturbances that can impact the normal operation and to minimize the disturbing emissions that can be generated and introduced in the electricity grid.

The typical range of the disturbances that usually causes problem is with a time duration of 0-500 milliseconds and voltage drop of -10 to -40%. Although, the most serious disturbances can reach -60%, when suffering greater lapses of time. The failure in the mains could produce a series of disturbances due to automatic reconnections while trying to correct these detected faults. This series of disturbances often requires that the voltage compensation equipment operates for several seconds.

According to the nature of disturbance, often identified by Power Quality Audits or historic data and nature of the load, user can decide whether to go for a voltage regulation solution or need to choose a Uninterrupted Power Supply (UPS) option.

Its highly recommended to make selection of PowerLogic DVR only after good analysis of the nature of sags as DVRs neither address short/long term interruptions nor the 3 phase sags beyond 70% (see the operating range for details).

The Solution

The PowerLogic DVR system is a IGBT based electronic , flexible compensator that injects and absorbs energy and helps to mitigate and eliminate the effect of electrical disturbances and offers an extremely stable voltage (Vn ±1%) with a very fast response.

The topology of the PowerLogic DVR system allows to continuously regulate nominal voltage up to a certain percentage or compensate voltage sag from deeper percentage without using energy storage such as battery or capacitors. Moreover, it mitigates other network quality problems, such as fluctuations, Flicker effects, regulation problems, and voltage imbalance. The PowerLogic DVR system has been specifically designed for the demanding process industry, semiconductor, and in general, for customers with sensitive loads which demands high stability in supply voltage.

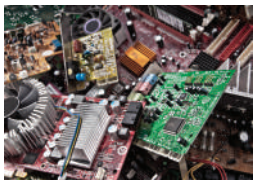
The following table shows the full range of PowerLogic DVR systems based on disturbance correction capabilities.

Continuous Regulation Range	Maximum Sag Without Voltage Alteration	Maximum Sag Without Switching to Static Bypass	PowerLogic DVR System Power
±20%	-40%	-70%	150 kVA
			220 kVA
			300 kVA
			440 kVA
			500 kVA
			600 kVA
			750 kVA
			900 kVA
+20% -25%	-50%	-70%	220 kVA
			440 kVA
			660 kVA
+20% -30%	-60%	-70%	150 kVA
			300 kVA
			450 kVA

Characteristics

- Mitigates three-phase voltage sags up to -70% deep or single-phase interruptions
- Continuous regulation to offer high stabilization (±1%)
- Very high operational efficiency (> 98%)
- Power ranges from 150 to 900 kVA
- Minimizes the necessary investment and operating costs
- Batteries or other energy storage components not required
- Compensation of voltage dips even for longer times (up to 30 seconds)
- Swell and overvoltage compensation up to + 20%
- Independent compensation per phase
- Compensation of balanced and unbalanced voltage drops
- Power supply to the load by Static Bypass in case of detected failure
- Overload in Normal mode: 150% overloads for 1 second
- Overload in Static Bypass mode: 200% for 60 seconds, 500% for 10 seconds and 3000% for 0.2 seconds
- High response speed (< 3 milliseconds)
- Energy flows in both directions
- Never interrupts the service
- Modular design that facilitates maintenance and repairs
- Easy to connect in parallel up to 3 units
- Mitigates voltage sags according to regulations: SEMI F47, IEC 61000-4-11, and IEC 61000-4-34 (depending on the model)
- Chronology of disturbances and monitoring system
- Touchscreen monitoring system

Typical Applications



Semiconductor Industries

Food & Beverages

Automotive Industries

Pharmaceutical Industries

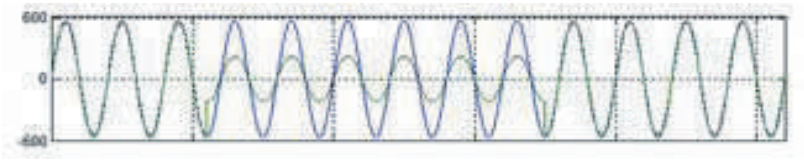
Textile Industries

PowerLogic DVR Operation Example

The PowerLogic DVR eliminates three-phase, two-phase, and single-phase sags as it compensates each phase independently.

The DVR is a flexible compensator that injects and absorbs energy. It mitigates and eliminates the effect of electrical disturbances to offer an extremely stable voltage (Vn ± 1 %) with a very fast response.

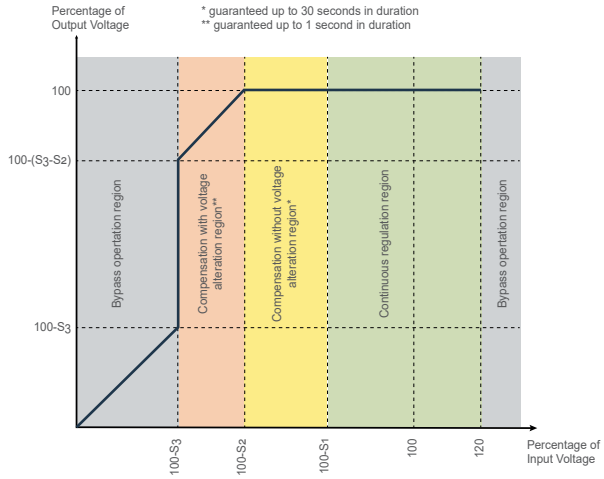
In this example, DVR system quickly responds to compensate for a sudden drop in the input voltage (shown in green) to ensure that the output voltage (shown in blue) remains stable.



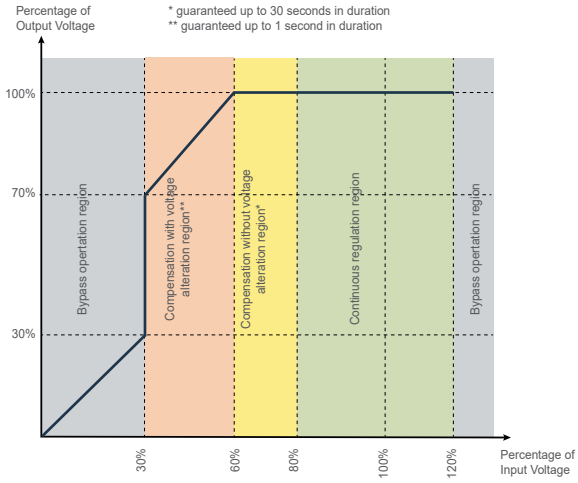
Sag/Time Curve for Three-Phase Sag

The below is the sag/time curves for L-L sag for the three types of equipments and the generic curve.

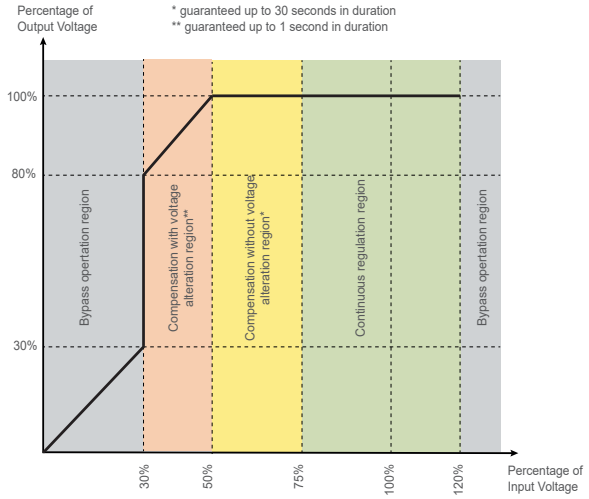
Generic Curve



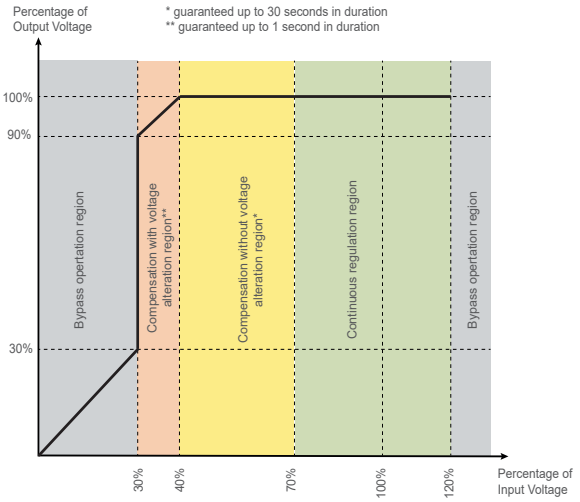
Three-phase sag DVR 300 kVA 40%



Three-phase sag DVR 220 kVA 50%



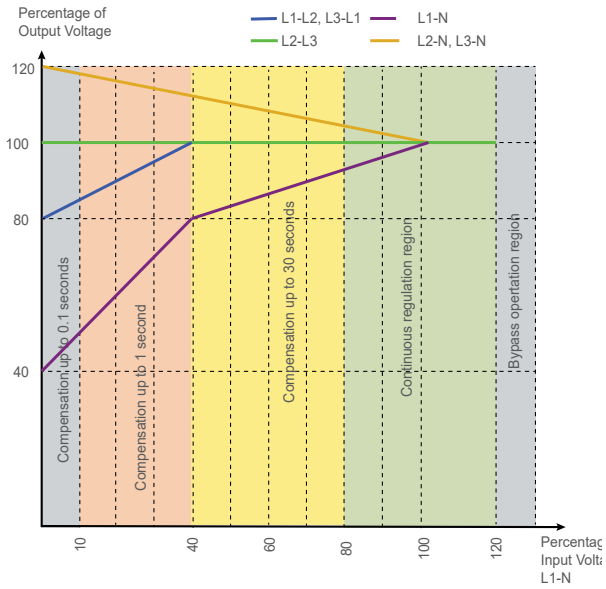
Three-phase sag DVR 150 kVA 60%



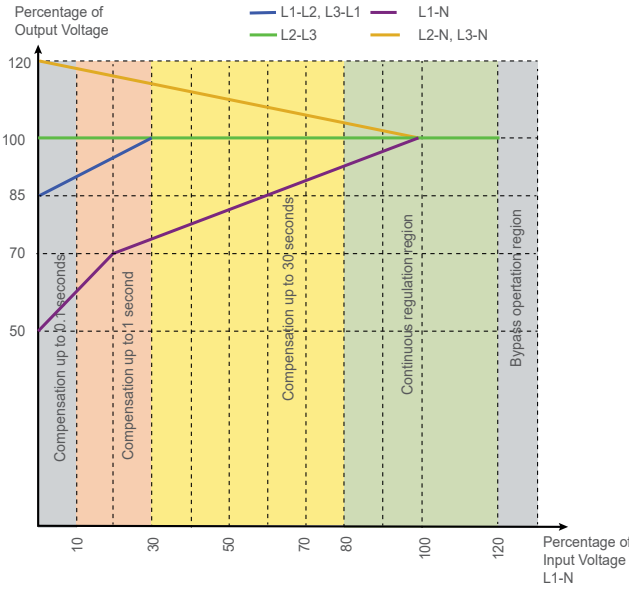
Sag/Time Curve for Single-Phase Sag

The below is the sag/time curves for L-L sag for the three types of equipments.

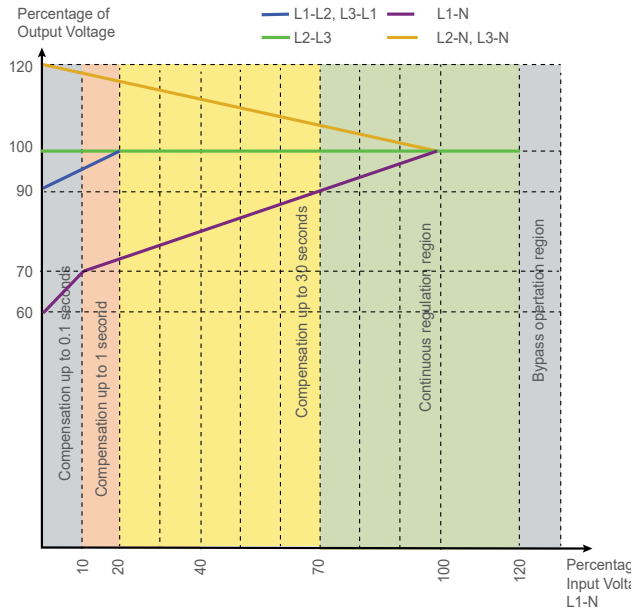
Single-phase sag DVR 40%



Single-phase sag DVR 50%



Single-phase sag DVR 60%



PowerLogic DVR System Configuration

The PowerLogic DVR system consists of one Master unit or by a parallel system consisting of one Master unit and a maximum of two Slave units.

The DVR systems require an additional Manual Bypass cabinet. It is mandatory to install this cabinet as it has the following functionalities:

- Allows continuous power supply to the load during the maintenance of the DVR system.
- Works as a distribution cabinet to facilitate the power connection between units that are in parallel in a system.

There are three types of Manual Bypass cabinets depending on the nominal current of the system: 630 A, 1250 A, 2000 A, and 3200 A.

Technical Specifications

PowerLogic DVR Specifications

Input

Available nominal voltage	200-208-220 V, 380-400-415 V (480 V when UL will be available)
Available nominal kVA	150 -900 kVA
Maximum input voltage (for continuous regulation)	20%
Supply Frequency	50 Hz or 60 Hz +/-10%
Power System	3ph with or without Neutral (Neutral not used/not connected on DVR)
Maximum THDu	THDu < 5% (recommended), <8% Maximum : output voltage regulated at +/- 1%; THDu > 8% (Short time only): output voltage regulated up to +/-3%. THDu Max limit - 10%
Acceptable Df/dt (Variation of Frequency)	3 Hz /s full range 50/60 Hz

Output

Voltage	The same of input nominal voltage (output voltage can be adjusted)
Admitted load variation	Up to 100%
Admitted load imbalance	Up to 100%
Admitted overload (Inverter)	inverter overload 110% 30 s , 150% 1 s
Output PF	No load power factor limitation

Performance

Efficiency	Global Efficiency ≥ 98% Linear load at nominal power PF 0,8 = 97,7% Linear load at nominal Power PF 1 = 98,1% Non-linear load at nominal Power = 97,4%
SAG correction response	<3 ms
Output voltage accuracy	+/1% typical
SAG correction accuracy	+/-1% (same as static accuracy)
Continuous regulation range	+20/ -20% ; -25%; -30%
SAG correction capability	For 3ph : -40 to -60% (depending range) for 30 s . For 1ph -100 % (during 100ms !!). Refer to 1Ph sag compensation chart enclosed
Output voltage comportments when outside of the voltage tolerance	Transfer on Ebypass

Static bypass

Nota 2: Short Circuit Withstand	30 In for 200 ms
Bypass Capacity/Overload	200% for 60 s 500% for 10 s 3000% for 200 ms (based on Thyristor withstand) If overload is exceeded equipment integrity is not guaranteed
Transfer time (from inverter to bypass)	<0.5 ms

External bypass

Rating	4 models 630, 1250, 2000, 3200 A
Components	3 Switches 3P Neutral not used
Connections	Connection to Source and Loads : By top or bottom Connection to DVR input and output : Bottom only

Buck/Boost transformer

Type	Dry transformer
Voltage drop/loss Uk (on electronic bypass) Equivalent series impedance	<2%
Service	
MTTR (rectifier/inverter/static bypass modules)	2 Hours for replacement if spares available
Preventive maintenance and components replacement (Spare Parts?)	Spare parts definition in progress precise maintenance conditions

PowerLogic DVR Specifications

Environment

Operating temperature range	0 °C to 40 °C (32 °F to 104 °F)
Storage temperature range	-15 °C/+45 °C
Operating altitude	<1000 m without derating
Inverter cooling	Forced Ventilation
Transformer cooling	Forced Ventilation
Max relative humidity	95% (non condensing)
Pollution degree rating / Overvoltage category	pollution degree 2/OV category 3
Noise	<75 dB

HMI

Screen	Colour Touch screen 9"
Languages	English, Chineese, Spanish
Diagnosis	Non-volatile Power Quality events and alarms log

Enclosure

Protection degree	IP20
Material	Cold rolled steel (DC01) for 1.5 mm Hot rolled steel (DD11) for 2-3 mm
Finish	Polyester powder painted metal sheet
Colour	RAL 7035
Enclosure access	Hinged doors without key lock (Special opening tool)
AC Power Cables access	Bottom only (from the base of the enclosure)

Standards

Marking	CE marking; Ctik; EAC
Safety	IEC 62477-1 (2016)
EMC	EMC : IEC 61000 6-2 & IEC 61000 6-4
SAG Performances	SEMI F47 (US)/IEC 61000-4-34 Requested and internal reports accepted
Environmental	ISO 14001
Quality	ISO 9001

Selection Table

The below table shows the system configurations for each PowerLogic DVR unit and the type of Manual Bypass cabinet required based on nominal voltage.

PowerLogic DVR 380/400/415 V, 50/60 Hz

Sag level	Rated power (kVA)	Bypass rating (A)	Commercial reference number				Bypass	
			Master reference	Qty	Slave refrence	Qty	Bypass refrence	Qty
40%	150	630 A	DVR15040400	X 1			DVRBP630	X 1
	220	630 A	DVR22040400	X 1			DVRBP630	X 1
	300	630 A	DVR30040400	X 1			DVRBP630	X 1
	440	1250 A	DVR44040400M	X 1	DVR44040400S	X 1	DVRBP1250	X 1
	500	1250 A	DVR50040400M	X 1	DVR50040400S	X 1	DVRBP1250	X 1
	600	1250 A	DVR60040400M	X 1	DVR60040400S	X 1	DVRBP1250	X 1
	750	2000 A	DVR75040400M	X 1	DVR75040400S	X 2	DVRBP2000	X 1
	900	2000 A	DVR90040400M	X 1	DVR90040400S	X 2	DVRBP2000	X 1
50%	220	630 A	DVR22050400	X 1			DVRBP630	X 1
	440	1250 A	DVR44050400M	X 1	DVR44050400S	X 1	DVRBP1250	X 1
	660	2000 A	DVR66050400M	X 1	DVR66050400S	X 2	DVRBP2000	X 1
60%	150	630 A	DVR15060400	X 1		X 1	DVRBP630	X 1
	300	1250 A	DVR30060400M	X 1	DVR30060400S	X 1	DVRBP1250	X 1
	450	1250 A	DVR45060400M	X 1	DVR45060400S	X 2	DVRBP1250	X 1

Selection Table

PowerLogic DVR 200/208/220 V, 50/60 Hz								
Sag level	Rated power (kVA)	Bypass rating (A)	Commercial reference number				Bypass	
			Master reference	Qty	Slave refrence	Qty	Bypass refrence	Qty
40%	150	630 A	DVR15040208	X 1			DVRBP630	X 1
	220	1250 A	DVR22040208	X 1			DVRBP1250	X 1
	300	1250 A	DVR30040208	X 1			DVRBP1250	X 1
	440	2000 A	DVR44040208M	X 1	DVR44040208S	X 1	DVRBP2000	X 1
	500	2000 A	DVR50040208M	X 1	DVR50040208S	X 1	DVRBP2000	X 1
	600	3200 A	DVR60040208M	X 1	DVR60040208S	X 1	DVRBP3200	X 1
	750	3200 A	DVR75040208M	X 1	DVR75040208S	X 2	DVRBP3200	X 1
	900	3200 A	DVR90040208M	X 1	DVR90040208S	X 2	DVRBP3200	X 1
50%	220	1250 A	DVR22050208	X 1			DVRBP1250	X 1
	440	2000 A	DVR44050208M	X 1	DVR44050208S	X 1	DVRBP2000	X 1
	660	3200 A	DVR66050208M	X 1	DVR66050208S	X 2	DVRBP3200	X 1
60%	150	630 A	DVR15060208	X 1			DVRBP630	X 1
	300	1250 A	DVR30060208M	X 1	DVR30060208S	X 1	DVRBP1250	X 1
	450	2000 A	DVR45060208M	X 1	DVR45060208S	X 2	DVRBP2000	X 1

PowerLogic DVR Bypass		
Bypass rating (A)	Commercial reference	Qty
630 A	DVRBP630	X 1
1250 A	DVRBP1250	X 1
2000 A	DVRBP2000	X 1
3200 A	DVRBP3200	X 1

Dimensions

Types of PowerLogic DVR system

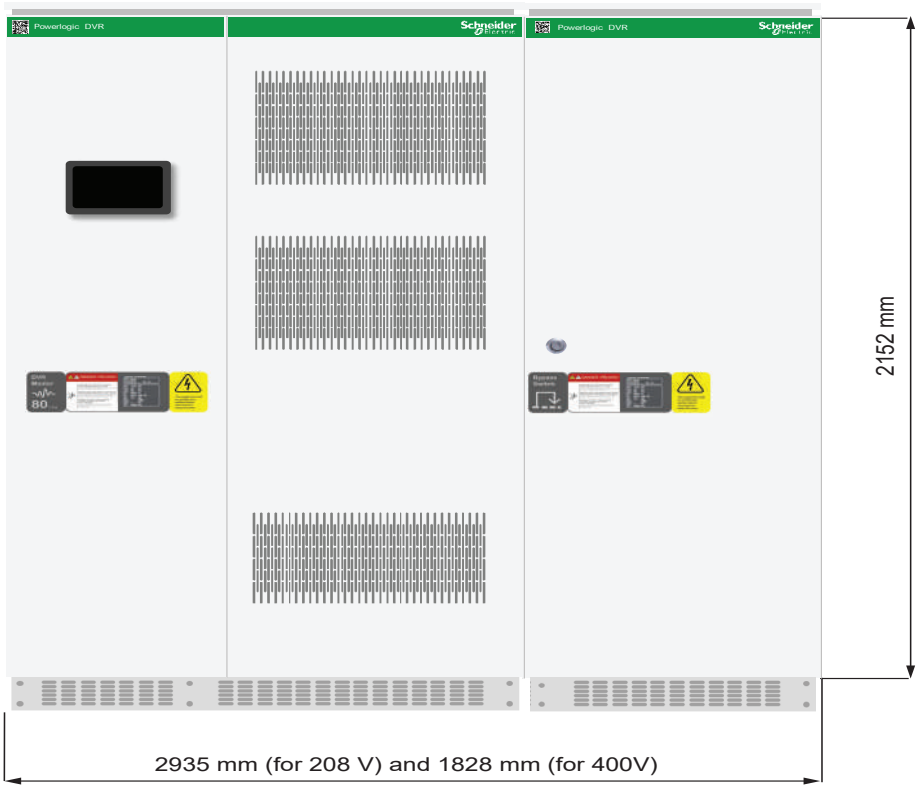
Types of PowerLogic DVR unit	Weight	Dimensions (Width × Depth × Height)
Master or Slave for 380/400/415 Vac	1250 Kg	1214 x 750 x 2152 mm
Master or Slave for 200/208/220 Vac	1600 Kg	1835 x 750 x 2152 mm

Types of Manual Bypass

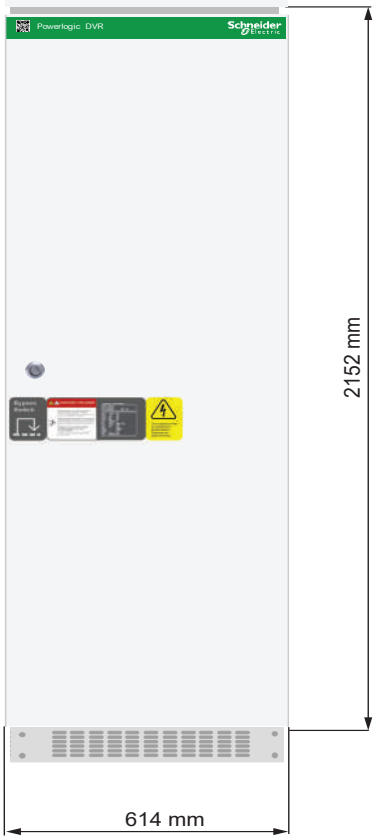
Types of Manual Bypass	Weight	Dimensions (Width × Depth × Height)
630 A	200 Kg	614 x 750 x 2152 mm
1250 A	375 Kg	1100 x 750 x 2152 mm
2000 A	575 Kg	1100 x 750 x 2152 mm
3200 A	775 Kg	1200 x 750 x 2152 mm

DVR Configuration with 1 Master Unit + 1 Bypass Unit

Example: 300 kVA, 400 V DVR with 630 A Bypass or 300 kVA, 208 V DVR with 1250 A Bypass

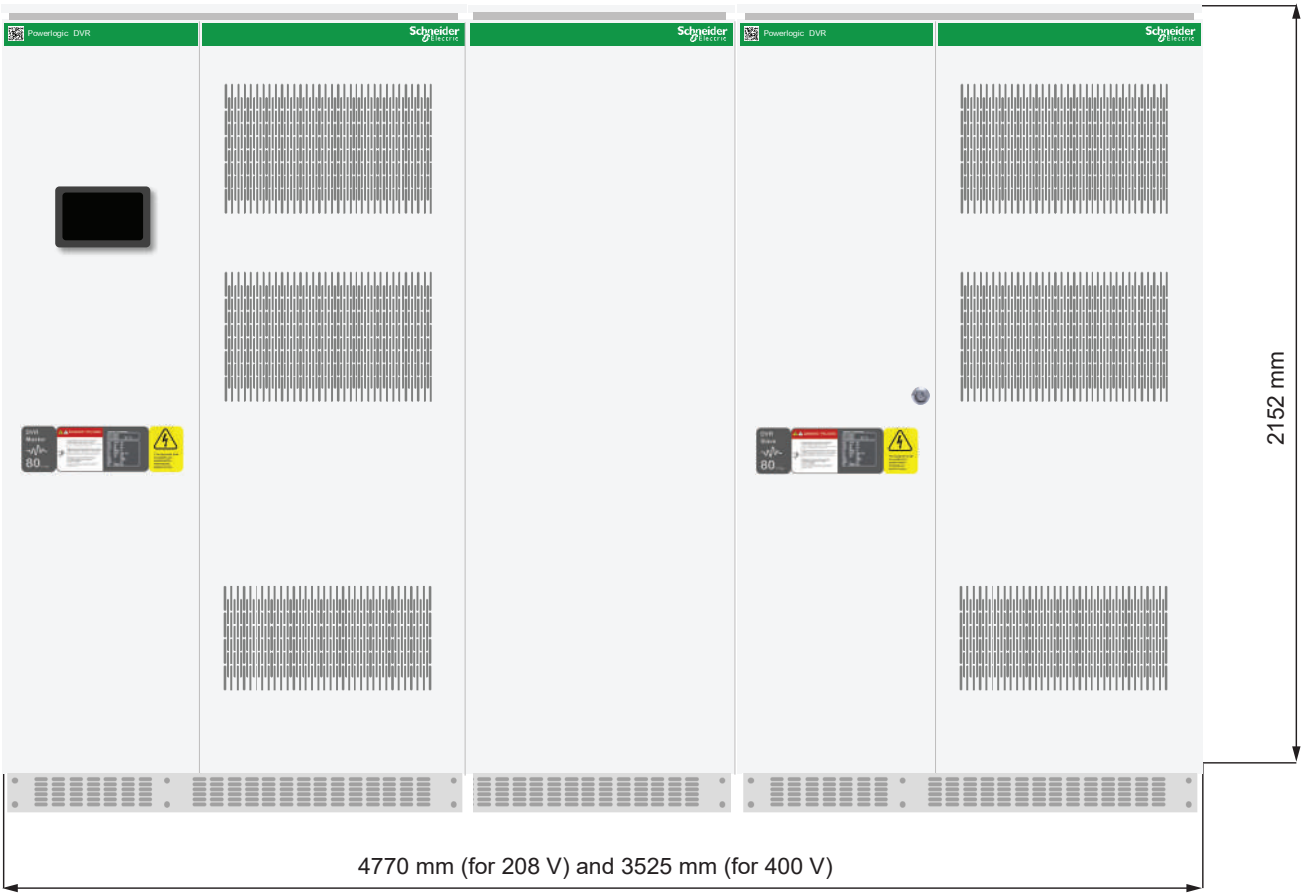


Bypass Unit 630 A



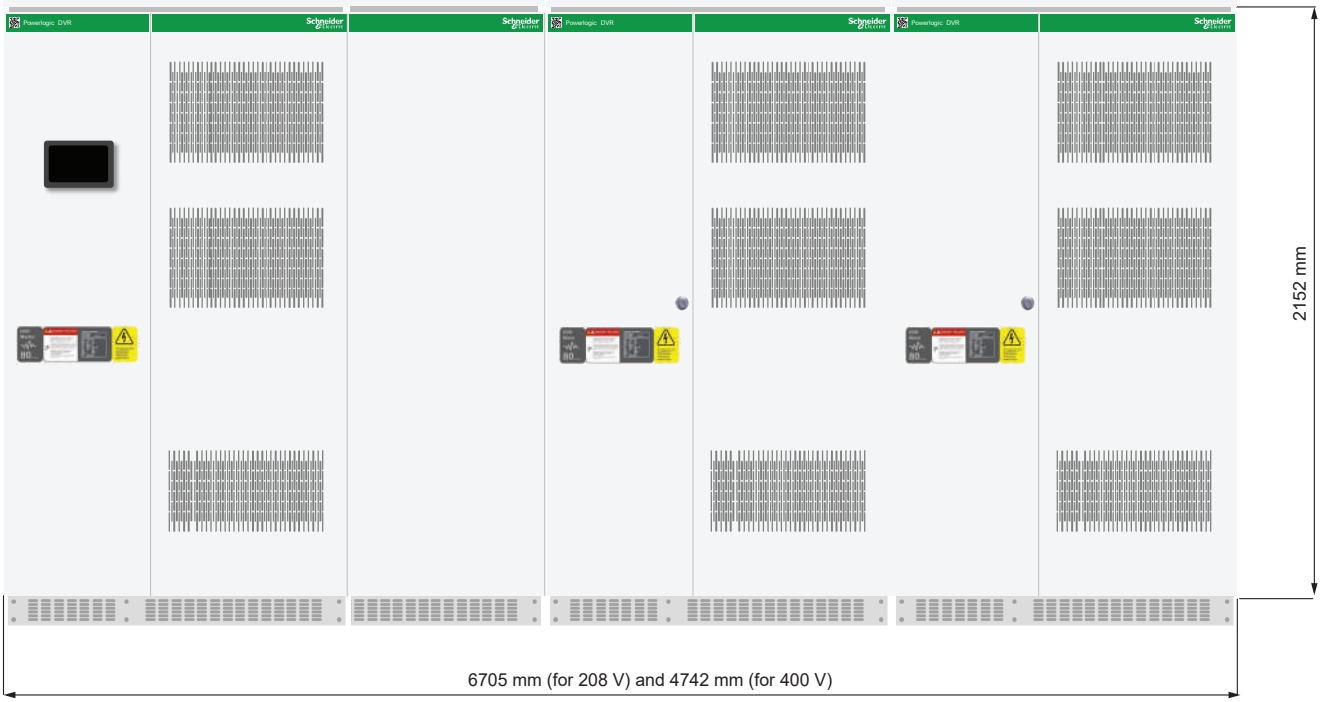
DVR Configuration with 1 Master Unit + 1 Slave Unit + 1 Bypass Unit

Example: 440 kVA, 400 V DVR with 1250 A Bypass or 440 kVA, 208 V DVR with 2000 A Bypass



DVR Configuration with 1 Master Unit + 2 Slave Units + 1 Bypass Unit

Example: 900 kVA , 400 V DVR with 2000 A Bypass or 900 kVA, 208 V DVR with 3200 A Bypass



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